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Verification of Translation

I, Gabriele Fuchs, residing at Amrumer Str. 7, 90425 Nuremberg, Federal Republic of Germany, hereby declare that I am conversant with the English and German languages and that I am a competent translator thereof. I declare further that, to the best of my knowledge and belief, the foregoing is a true, faithful, complete and accurate translation of PCT International Application PCT/DE2003/003193 as filed on September 25, 2003 in the name of Conti Temic microelectronic GmbH, the original of which application has been submitted to me in the German language.

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Method for Operating an Electronic Module which is Supplied with Electrical Energy by an Operating Voltage Source.

The invention relates to a method for operating an electronic module which is supplied with electrical energy by a voltage source according to the preamble of patent claim 1.

An electronic module of this type is known from DE 197 15 571 A1, wherein a system-autonomous capacitor is charged from an up-converter supplied by an operating voltage source to a value lying above the operating voltage, in order to operate with it a down-converter which is series-connected to the system-autonomous capacitor. This down-converter supplies several electronic modules, which each comprise a function-autonomous capacitor as an energy storage, to ignite a passenger protection equipment, such as e.g. an airbag, in the event of an operating voltage failure. Thus, this reserve energy serves as an ignition energy for igniting a pyrotechnic gas producer.

Fig. 2 shows a simplified block diagram of this known electronic module, which is composed of an up-converter 1, a down-converter 2 which is series-connected to the up-converter 1 and a power module 3 connected to the down-converter 2, these functional units being controlled by a microprocessor μC. The power module 3 on its part triggers a security unit 4, as for example an airbag, a seat belt tensioner or a roll-over bar. Via an ignition switch S_Z the up-converter 1 is supplied with an operating voltage source, which is as a rule the battery voltage U_{bat}. A system-autonomous capacitor C_S connected to the connection line of the two voltage converters 1 serves for bridging

the voltage interruption in the event of a battery voltage failure, e.g. with an accident entailing the functional deficiency of the vehicle battery. For this purpose, said system-autonomous capacitor C_S is charged by the up-converter 1 to a value lying above the battery voltage U_{bat}. A further capacitor C_Z, connected to the output of the down-converter 2, serves as an ignition-autonomous capacitor, to likewise ensure the ignition energy for the pyrotechnic triggering of a security unit 4 in the event of an operating voltage failure.

The advantage of this known electronic module is that for charging both the system-autonomous capacitor and the function-autonomous capacitor a complex method is necessary.

It is, therefore, the object of the invention to indicate a method for operating an electronic module of this type, which can be easily implemented and which requires a low circuit expenditure.

This object is achieved by the features of patent claim 1. Accordingly, the function-autonomous capacitor is connected both to the voltage converter and to the system-autonomous capacitor by means of a charging connection, said charging connection being controllable in order to fulfill various functions in different operating states. For charging the two autonomous capacitors, i.e. in particular during the starting phase of the electronic module, the charging connection is controlled in a switching mode for clocking the charging current. In contrast, both for checking the system-autonomous capacitor and for producing a re-loading current for re-loading the function-autonomous capacitor,

the charging connection is operated as a controllable resistance, i.e. as a current source for producing a constant discharging current.

With this method according to the invention apart from the reliable charging of the function-autonomous capacitor additional functions can be fulfilled, in particular, checking the system-autonomous capacitor can be controlled with the charging connection by its discharging into the function-autonomous capacitor.

The method according to the invention can be implemented in easy manner, in particular if the charging connection is composed of at least one transistor element and of a resistance which is series-connected to it, in particular if merely a single transistor with high ampacity is connected in series to the resistor between the two autonomous capacitors.

With a preferred further development of the method according to the invention the voltage converter is embodied as an up-converter.

The method according to the invention can advantageously be used in a motor vehicle control device for passenger protection equipment, wherein an ignition-autonomous capacitor ensures as a system function the provision of the ignition energy for the pyrotechnic triggering of the security units.

The method according to the invention shall be described and shown on the basis of an example of embodiment taken in conjunction with Fig. 1.

Here, Fig. 1 shows a block diagram of a control circuit 10 for security units 4, such as airbags, seat belt tensioners, belt load limiters and roll-over bars in motor vehicles. This control circuit contains an up-converter 1, which via an ignition switch S_Z is connected to an operating voltage source, for example the vehicle battery, by means of the terminal 15, to be supplied with an operating voltage U_{Bat} of e.g. 24V. From this said up-converter 1 produces a voltage lying above it of e.g. 48V, with which a system-autonomous capacitor C_S is charged and simultaneously with this operating voltage U_S a charging connection 5 and a down-converter 2 is supplied. This down-converter 2 produces from the operating voltage U_S for example an operating voltage $U_{\mu C}$ for both a microprocessor μC and operating voltages U_{Sat} for further modules, e.g. sensor groups, in particular for side-crash-recognition.

The charging current 5 substantially shows only the most important elements, namely a series pass transistor T, whose collector electrode is connected to the operating voltage U_S, whose source electrode is applied via a resistance R to the output of this charging connection and is connected directly to an ignition-autonomous capacitor C_Z and an ignition power module 3 for triggering a security unit 4. Simultaneously, current sources 6 and 7 are supplied by this charging connection 5, whose functions are described below. The ignition-autonomous capacitor C_Z is charged by the charging connection 5 to a voltage $U_{Zünd}$ and in the event of operating voltage interruptions provides the ignition energy in the event of the triggering of a security unit 4 via their allocated ignition power module 3.

The mentioned functional groups of this control circuit 10, i.e. the up-converter 1, the charging connection 5, the voltage sources 6 and 7, the ignition power module 3 and the down-converter 2 are controlled by the microprocessor μC, which for their control detects adequate voltage levels via the lines a, b and c. To simplify matters, further functional groups required for the function as a control circuit for security units, such as e.g. sensors, are not shown.

The function of this control circuit 10, in particular of the charging connection 5 shall now be described in the following. After closing the ignition switch S_Z at first before regular operation the circuit is booted up within a softstart by appropriate clocked control of the up-converter 1. During this softstart the transistor T of the charging connection 5 is controlled to the closed state, so that therewith not only the system-autonomous capacitor C_S, but also the ignition-autonomous capacitor C_Z is supplied with charging current. The softstart operation is followed by a booster operation, wherein the two autonomous capacitors C_S and C_Z are charged to the respective voltage U_S and $U_{Zünd}$, resp. With this the transistor T of the charging connection 5 is operated as a switch both in the softstart mode and in the booster mode.

As the two autonomous capacitors C_S and C_Z comprise a security relevant function, namely ensuring operation of the control circuit and provision of ignition energy in the event of a failure of the operating voltage source caused by an accident, said capacitors must be subject to testing at regular intervals. The capacitor testing for the system-

autonomous capacitor C_S is effected by being discharged via the controlled charging connection 5 into the ignition-autonomous capacitor C_Z. This capacitor test can be implemented subsequently to the softstart with an opened transistor T of the charging connection 5 or - as is explained below - by means of the microprocessor μC after a discharge of the ignition-autonomous capacitor C_Z effected in the opened state of the transistor T of the charging connection. In this connection the said transistor T operates as a controlled resistance, by being controlled by the microprocessor μC as a current source for producing a constant current. Before carrying out this capacitor test, however, the ignition-autonomous capacitor C_Z must be discharged to ground in defined manner. This happens with a current source 6, which is triggered accordingly by the microprocessor μC. During this discharging process the transistor T of the charging connection 5 is controlled in a circuit operation, i.e. in this case blocked, so that based on its high impedance no current can flow from the system-autonomous capacitor C_S into the circuit branch which is series-connected to the charging connection 5.

Due to a low self-discharge of the ignition-autonomous capacitor C_Z and a low current consumption of the ignition power module 3, during operation of said ignition-autonomous capacitor C_Z re-loading is necessary. For this purpose the transistor T of the charging connection 5 is operated again as a controlled resistance via an appropriate triggering of the microprocessor μC, for producing as a re-loading source a very low re-loading current for the ignition-autonomous capacitor C_Z.

When shutting down the control circuit 10, i.e. when

opening the ignition switch S_Z, the ignition-autonomous capacitor C_Z must be discharged to ensure that unintentional ignition of the security unit 4 is not possible. This is realized by the fact that the ignition-autonomous capacitor C_Z is discharged by means of triggering a discharge current source 7 by means of the microprocessor μC.

The exemplary control circuit 10 according to Fig. 1 shows only a single ignition power module 2 with a security unit 4. In case of need, of course, several ignition power modules with a respectively allocated security unit can be connected to the output of the charging connection 5 and the ignition-autonomous capacitor C_Z, resp. Furthermore, it is also possible that one ignition power module each with allocated security unit is supplied by a charging connection each with separated ignition-autonomous capacitor.